volved. In the main features of the scheme nearly all the witnesses who were examined on the subject are at one; many of the details in which they differ are of such a nature as can be settled only by actual trial.

On the many other subjects touched upon in the volume we cannot enter here. Much of the evidence bearing on the Universities tends to prove that the interests of Science are inadequately attended to in these institutions, and that the scientific teachers in some of them have to contend with very great difficulties. With respect to what Universities should do to advance the interests of Science, not to speak of the utilisation of the enormous funds at the disposal of Oxford and Cambridge, such men as Dr. Siemens, Dr Frankland, Dr. Sanderson, and others are of opinion that for the highest degrees in Science original research should be required; Prof. Balfour-Stewart thinks that Universities ought to afford facility for the prosecution of original research, and Dr. Carpenter that University Fellowships should be given to men employed in original research.

Many of the most eminent witnesses—as Sir B. Brodie, Lord Salisbury, Dr. Frankland, Prof. Williamson, Colonel Strange, Sir William Thomson, &c.—are of opinion that research ought to be endowed quite apart from teaching in the ordinary acceptation of the term.

Most of the witnesses who spoke to the condition of Science in this country contrasted it with the great encouragement given to research in nearly every other European country, and in America. In this relation we cannot help quoting a very striking statement made by Sir William Thomson in respect to France, in answer to the question as to how many institutions for research he would recommend.

"There should be five," he says. "One at present exists, namely, the Royal Observatory at Greenwich. Another in my opinion is very much wanted, an observatory for astronomical physics; then again a physical laboratory, and a laboratory for chemical research, and a physiological laboratory are necessary. In respect of such institutions, I believe, we might with great advantage obtain information, with a view to following example, in Paris. The strong feeling of the necessity to promote scientific research which was evinced shortly after the recent sad disasters which came upon France illustrates very strongly the national value of such institutions. In the depths of their misfortunes, one of the first strong feelings shown by the most intelligent part of the French nation was the want of rigorous and accurate scientific research. Competitive examinations seemed in France to have swallowed up scientific energy, and there was a strong feeling of the insufficiency of the national institutions for promoting the advancement of Science."

In conclusion, we cannot do better than quote the forcible and noble language of Sir William Thomson, on the much-discussed question of the "utility" of abstract scientific research. To the question as to some of the objects to be gained by the establishment of a Council of Science, Sir William Thomson replies:—

"The immediate utility of the work is undoubtedly a very important object, and perhaps may be considered to be the first duty of the Government; but yet there is another duty which, although we cannot call it the first duty, is certainly not an inferior duty, and that is, to promote the honour of this country. There can be no doubt but that the inhabitants of this country do get benefit from the feeling of satisfaction that naturally results from any great scientific discoveries or great advances in Science made by their own countrymen, and especially by the assistance of their own Government. The Royal Observatory at Greenwich is an honour and a glory to this country, and I am quite sure that the money paid for it is very well spent, in the satisfaction that the country feels in the honour of having one of the greatest and best, if not *the* greatest and best, of scientific astronomical observatories in the world. This country undoubtedly has a great permanent possession in the name of Newton and in the name of Faraday. The promotion of scientific research in a regular way cannot make Newtons and Faradays, but it can obtain great scientific results by systematic business-like action, carried out through well-instructed and able men. It seems to me to be a duty of the Government to make the national honour in scientific investigation a subject of its solicitude and an occasion (with due safeguards against abuse) for spending the public money." J. S. K.

OUR BOOK SHELF

Proceedings of the London Mathematical Society, vol. iv. Nos. 41-66. (Messrs. Hodgson, Gough Square.)

THE volume before us contains the papers which have been read during the eighth and ninth sessions of the Society. We notice a favourable sign in the much greater number of contributions which have been made in the later session—36 against 15. A large number of the members have been led to take an interest in the meetings, and the papers without losing their former high character are in some cases less "caviare to the general" than in previous volumes. The Society's first president himself thus wrote, "Not a drop of liquor is seen at our meetings, except a decanter of water; all our 'heavy' is a fermentation of symbols, and we do not draw it mild. There is no penny fine for reticence or occult science; and as to a song! not the ghost of a chance." The Society, however, as we see, has reached its tenth year; and though some of the members drop off for reasons which perhaps may be gathered from our quotation, yet the number of members recorded in this volume is fairly satisfactory: the present number of members of the Mathematical Society is about 117. In Paris the new Society (la société mathématique de France) started with almost double this number of members. So far as we have seen, however, the papers of the volume under notice and of previous volumes will not lose by a comparison with the opening numbers of the younger society's *Bulletin*. Of course no volume would fairly represent English mathematics without having contributions from Prof. Cayley's fertile pen; here we have no less than ten papers, some of considerable length, principally on curves and surfaces, and constructions for mechanically describing the former.—Dr. Sylvester furnishes only short notes on the properties of numbers.—Prof. H. J. S. Smith contributes an arithmetical demonstration of a theorem in the integral calculus, and two other papers bearing upon linear congruences and determinants.—Prof. W. K. Clifford writes, among other things, upon geometry, on an ellipsoid, and a new form of Biquaternion.—Mr. Samuel Roberts rivals Prof. Cayley in the extent and nature of his communications upon parallel surfaces, and also upon epi- and hypo-trochoids.—Prof. Clerk-Maxwell takes us to another sphere, and treats of the transformation of solids, of the equations of motion, of a system of electrified conductors, and of the focal lines of a refracted pencil.—Lord Rayleigh too takes us into the domain of physical science, in his vibrations in a sphere, the investigation of the disturbance produced by a spherical obstacle on the waves of sound, general theorems relating to vibrations.—A presidential address by Mr. Spottiswoode treats of some recent generalisations of algebra.—Mr. J. W. L. Glaisher writes on

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Bernoulli's numbers, and on points connected with definite integrals.—Prof. Wolstenholme's papers are concerned with series and loci, and treat also of epicycloids and hypocloids.—Mr. T. Cotterill gives a short paper on an algebraical form and the geometry of its dual connection with a polygon, plane or spherical.—An analogous theorem relating to polyhedra is discussed by Prof. Clifford in this same volume.—M. Hermite contributes two short notes, one on circular functions, the other on unicursal curves.—Mr. J. J. Walker writes on the invariant conditions of multiple-concurrence of two conics, and Mr. R. B. Hayward on an extension of the term *Area* to any closed circuit in space.—From this analysis it will be seen that there is considerable variety in the contents of the volume. It is not necessary here to give any detailed account of the papers, as notices of them have appeared from time to time in our columns.

LETTERS TO THE EDITOR

The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.]

Flowers of the Primrose destroyed by Birds

I HOPE that you will permit me to make a few final remarks on the destruction of primrose flowers by birds. But first I must return my best thanks to your correspondents, as well as to some gentlemen who have written direct to me, and to whom I have not had time to send separate answers. Secondly, I must plead guilty to the high crime of inaccuracy. As the stalks from which the flowers had been cut were shrivelled, I mistook, in a manner now inexplicable to me, the base of the ruptured or removed ovarium for the summit; a remnant of the shrivelled placenta being mistaken for the base of the pistil. I have now looked more carefully, and find that on twelve stalks only three had any remnant of the ovarium left. I have also examined sixteen bits of the calyx which had been cut off by a caged bullfinch, presently to be noticed, and in fifteen of these not only had the ovarium been torn into fragments or quite destroyed, but all the ovules had been devoured, excepting sometimes one or two. In several cases the calyx had been split open longitudinally. The ovarium was in the same state in thirteen small portions of the calyx lying on the ground near a wild cowslip plant. It is therefore clear that the ovules are the chief attraction; but the birds in removing by pressure the ovules could not fail to squeeze out the nectar at the open end, as occurred when I squeezed similar bits between my fingers. The birds thus get a dainty morsel, namely, young ovules with sweet sauce. I still think that the nectar is, in part, the attraction, as caged bullfinches and canary birds much like sugar; but more especially because Mr. C. J. Monro has sent me some flowers from a cherry-tree near Barnet, which during several years has been attacked; and he finds many of the flowers, both those on the tree and on the ground, with rather large ragged holes in the calyx, like, but much larger than, those often made by humble bees when they rob flowers in an illegitimate manner. Now the inside of the flower of the cherry, round the ovarium, is bedewed (if protected from the visits of insects) with drops of nectar, which sometimes collect so as almost to fill up the bottom of the flower. In the case of the cherry I cannot doubt that this is the attraction, for I examined the ovarium of ten flowers, and although they had all been scored by the bird's beak, and in four instances punctured, the ovule had in no case been devoured.

To return to the primroses: from the accounts received, it seems that the flowers are cut off in the manner described by me, near Preston in Lancashire, in North Hampshire, Devonshire, and Ireland, as well as in Kent. In several other places, not worth specifying, where primroses are abundant, they have not been thus attacked; and this may possibly be due to the proper enemy, namely, as I now suspect, the bullfinch, not being a common bird. In my former letter I remarked that if the habit of cutting off the flowers proved to be a widely extended one, we should have to consider it as inherited or instinctive; as it is not likely that each bird should discover during its individual lifetime the exact spot where the nectar, and, as I must now add, the ovules, lie concealed, or should learn to bite off the flower so skilfully at the proper point. That the habit is instinctive, Prof. Frankland has given me interesting evidence. When he read my letter he happened to have in the room a bunch of cowslip flowers and a caged bullfinch, to whom he immediately gave some of the flowers, and afterwards many primrose flowers. The latter were cut off in exactly the same manner, and quite as neatly, as by the wild birds near here. I know that this is the case by having examined the cut-off portions. The bird worked so quickly that he easily destroyed twenty flowers in three minutes; a single wild pair would therefore cause great havoc. Prof. Frankland informs me that his bird pressed the cut-off portions of the calyx in its beak, and gradually worked them out on one side, and then dropped them. Thus the ovules were removed, and the nectar necessarily squeezed out. A canary bird to whom some cowslip and primrose flowers were given attacked all parts indiscriminately, and ate up the corolla, calyx, and stalks. A lady also informs me that her canary and siskin always attack primrose and cowslip flowers, if kept in the same room. They generally first make a ragged hole through the calyx opposite the ovarium, and remove the ovules, as I found to be the case with flowers which were sent to me; but the ovules had not been so well removed as by the bullfinch, and the nectar could not be obtained by this method of attack.

But now comes the interesting point: the caged bullfinch just referred to was caught in 1872 near Ventnor, in the Isle of Wight, soon after it had left the nest, by which time the primroses would have been out of flower, and since then, as I hear from Prof. Frankland, it had never seen a primrose or cowslip flower. Nevertheless, as soon as this bird, now nearly two years old, saw these flowers, some machinery in its brain was set into action, which instantly told it in an unerring manner how and where to bite off and press the flowers, so as to gain the hidden prize. We are reminded by this little fact of Mr. Spalding's admirable observations on the instinctive actions of chickens when their eyes were uncovered, after having been blind-folded from the moment of being hatched.

Prof. Frankland seems to have been much struck with the behaviour of his bullfinch, and remarks in his letter that "it had all the precision of a chemical reaction; the result of putting a primrose within its reach can be almost as certainly predicted as that of putting a plate of iron into a solution of sulphate of copper." CHARLES DARWIN

Down, Beckenham, Kent, May 7

P.S.—This letter was printed before I saw your last number, and I am glad to find that some of my statements are confirmed, more especially with respect to bullfinches. During the last fortnight not one primrose has been attacked in the little wood where shortly before there was such havoc. I imagined that the pair of bullfinches, which I saw there earlier in the season, had wandered away; but yesterday evening (May 10) it occurred to me that the flowers produced late in the season might fail to secrete nectar, or that the recent cold weather might have produced this effect. Accordingly, in the afternoon I gathered fifteen flowers from as many distinct plants, and kept them in water in my room for seventeen hours. Earlier in the season I treated some flowers in this same manner, and found the tube of the corolla full of nectar; but now only one of the flowers contained a very small quantity of nectar, another showing a

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